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STRAWBERRIES

GUIDE TO CHEMICAL WEED CONTROL FOR STRAWBERRY PRODUCTION IN ATLANTIC CANADA 1989

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INTRODUCTION

Controlling weeds is the number one cultural problem faced by many strawberry growers. Strawberry beds must be kept free of weeds for several years if a reasonable return on investment is to be achieved. Because strawberries are grown as a perennial crop through several crop cycles, strawberry beds are annually subjected to infestation by a variety of weeds establishing at different times of the year. Grasses and broadleaf weeds may be perennial, summer annuals, winter annuals or biennials. For this reason, growers must have a good understanding of weed biology and how the herbicides used in strawberry production actually controls weeds. This knowledge is necessary to develop an effective weed control program. A weed control program is a pre-planned approach to weed control. This program should take into consideration all the factors that influence weed control and crop growth with the aim of maximizing crop growth and minimizing costs.

Some of the herbicides used in strawberry production will control certain established weeds. However, control of the most established weeds is poor. Therefore, the major aim of a weed control program should be to control weeds in the seedling stage when they are most sensitive and before they affect crop growth. This will require sequential applications of herbicides to coincide with weed seed germination. Table 2 will be useful in choosing the sequential treatments necessary to control the weed flora in your fields.

PRINCIPLES OF WEED CONTROL

1. No single herbicide will control all weeds.

2. If one species of weed is not controlled in a field and all others are, the uncontrolled species will take over. For example if a herbicide controls broadleaf weeds but not grasses, grasses will eventually become the predominant weed problem.

This problem of "shifts" in the dominant weed species in a field can be largely avoided by using combinations of herbicides or alternating herbicides from application to application. It is also important to control weed misses (uncontrolled species) with cultivation or spot spraying whenever they appear. As herbicides are selective in terms of which weeds each will control it is essential to accurately identify the problem weeds in your field, and match them to the sensitive species listed on the herbicide label. Table 1 provides help in choosing the appropriate herbicide to control specific weed species.

Weed flora refers to the specific community of weed species that are found in individual fields. This flora may differ significantly from field to field depending on past cultural practices, crops and soil types.

WEED BIOLOGY

The life cycle and reproductive behavior of a weed species are important factors to consider when planning a control strategy. Weeds can be classified accordingly as perennials, summer annuals, winter annuals and biennials.

Perennials

Perennial weeds persist year after year. Some perennials, like ox-eye daisy and dandelion persist as individual plants. Others like the Canada thistle and couch grass, can produce large clones (colonies) of plants that arise from spreading underground root stock or rhizome systems. All perennials can reproduce vegetatively. They can produce new plants from the growth of specialized reproductive organs like rhizomes, tubers, stolons or root stocks.

The importance of seed production in the life cycle of a perennial weed depends on the species. Some perennials like dandelion and ox-eye daisy spread primarily by seed. It is only when they are cut up and distributed by cultivation that vegetative reproduction is important. Sheep sorrel and toadflax reproduce by both seed and vegetative means. In contrast, the most serious weed program in strawberries, couch grass (quackgrass) reproduces almost exclusively by rhizomes. In order to have a strawberry planting free of couch grass and other perennials, the vegetative structures should be destroyed prior to planting using **Roundup** and cultivation.

Seedlings must be controlled through the use of cultivation and preemergence herbicides as they emerge. Dandelions and toadflax germinate profusely in late spring or early summer, whereas ox-eye daisy and sheep sorrel germinate mainly during early fall. Therefore, the appropriate preemergence herbicide must be present in the soil at levels effective for control of seedling perennials at both times of the year. Underground reproductive organs of these weeds should always be destroyed during the growing season prior to planting the crop.

Summer Annuals

Summer annual weeds include many of the most common farm weeds such as lamb's quarters, wild radish, hempnettle, redroot pigweed and corn spurry. These plants germinate mainly from mid-April to early July. They produce seed and die in one growing season. A characteristic of these weeds therefore, is a

very rapid growth rate once the seedling is established. This rapid early weed growth is very detrimental to strawberry plant growth, especially in the summer through to early fall. Any plants that do germinate late in the growing season are usually killed by frost.

Winter Annuals

Winter annual weeds germinate from late August through early November and overwinter in a rosette stage. A rosette is a circular cluster of leaves usually growing nearly flat on the soil surface. They bolt, flower, produce seed, and die the following spring or early summer. Some winter annuals will also germinate during early spring when soil temperatures are low. Winter annual weeds must be controlled as they germinate during late summer and early fall. Controls applied in late fall or early spring are usually not effective on established rosettes of winter annuals. Winter annual weeds commonly found in strawberries include shepherds purse, mouse-eared chickweed, field violet and common chickweed.

Biennials

Biennials have not been serious problem weeds in strawberry fields. Biennial weeds germinate in the spring, grow vegetatively during the first growing season, overwinter as a rosette, then flower, produce seed and die during the second growing season. Examples of the biennial life cycle are wild carrot, evening primrose and yellow rocket.

Two excellent publications used in the identification of weeds are:

WEEDS OF ONTARIO ($5.00)
Available from:
Consumer Information Branch
Ontario Ministry of Agriculture and Food
801 Bay Street, 12th Floor
Toronto, Ontario
M7A 2B2

WEED SEEDLING IDENTIFICATION (free)
Available from:
Print Media Branch
Alberta Agriculture
9718-107 Street
Edmonton, Alberta
T5K 2C8

I. SITE PREPARATION BEFORE PLANTING

The most troublesome weeds in strawberry production are perennials. Most perennial weeds cannot be controlled effectively with available herbicides in the spring before planting or once the crop is planted. Therefore, growers should strive to eradicate established perennials during the previous season. Ideally the herbicide **Roundup** should be applied in the summer prior to planting when weeds are actively growing. Allow one week for **Roundup** to translocate throughout the root system before plowing under. This should be followed by repeated shallow cultivations as green "flushes" of weed seedlings appear.

Smother crops such as buckwheat or annual ryegrass in the season prior to planting are strongly recommended to clean up weedy land. They can be used in conjunction with a **Roundup** treatment and summer fallowing. Smother crops are considered by many growers to be especially effective on many broadleaf perennials such as toadflax and tufted vetch.

If a grower cannot summer fallow weedy land, do not fall or spring plow. Allow weeds to grow undisturbed as late as possible. Mid-May applications may control quackgrass but broadleaf weed control may be poor. Early fall applications to undisturbed weeds may be more effective against broadleaf weeds than the mid-May application.

II. FIELD SANITATION

Windbreaks, fencelines and headlands can serve as a source of reinfestation of clean fields if they are not kept weed free. Refer to *Guide to Weed Control*, O.M.A.F. Publication 75 for recommendations for managing weeds in fencerows and shelterbelts.

Cultivation equipment should be checked for weed parts, such as quackgrass rhizomes, which may reinfest fields if not removed from the equipment.

Straw mulch should be weed-free. Some of the worst weeds are introduced in the straw. For this reason, it is a good practice to inspect the field from which you plan to obtain your supply of straw before harvest.

III. THE PLANTING YEAR

The weed control program should promote vigorous crop growth and have the field relatively weed-free by the time mulch is applied in late fall. Cultivation should be used in conjunction with herbicides. Cultivation is especially important to prevent the rapid growth of annual weeds during the critical four to six week period after planting as the crop establishes. The treatments

are effective primarily against germinating or very small seedlings. **Treflan** (which controls annual grasses and some broadleaf weeds from seed) must be applied to a well prepared seedbed and incorporated into the soil before planting. Only **Sinbar** and **Tenoran** will control weed seedlings up to 5 cm tall. Cultivation must be used prior to applications of **simazine, Enide, Devrinol** or **Dacthal** if weeds have emerged. All these herbicides act primarily through the roots and require irrigation or rain to be effective. The herbicides with the greatest weed control activity (i.e. **Sinbar** and **simazine**) generally have a narrower margin of safety to the crop than those herbicides with less herbicidal activity (**Tenoran, Enide, Devrinol,** and **Dacthal**). These should be applied only after the crop is well established.

In fields that have been fumigated at herbicidal rates, annual weed growth will be largely controlled. Do not use additional herbicides in such situations unless necessary.

Winter annual weeds and seedling perennials establishing in late summer and early fall are often overlooked until they are too large to be effectively controlled. Growers should watch their fields closely at this time of year to determine if weeds are germinating. If a flush of germinating weeds is observed, a herbicide application may be required provided the maximum number and rate of treatments have not already been applied. Be sure to use a herbicide that will be effective on the emerging species (refer to Table 1).

Late fall applications of **simazine** or **Sinbar** are not very effective in controlling established winter annuals and perennials. These treatments are recommended to provide residual weed control in the spring and early summer of the fruiting year.

Many weeds are introduced through the use of straw mulch infested with weed seeds. Some of the most difficult weeds such as toadflax, tufted vetch and field violet are often introduced in this manner. Growers should ensure that their mulch is free of weed seed.

The spray schedule (Table 2) lists the choice of treatments that can be used to controls specific weeds or weed groups at various treatment times throughout the season. Apply only one herbicide or herbicide combination (tank-mix) at each application time. Growers must be careful not to exceed the maximum application rate or total number of applications per season for a particular product.

IV. THE FRUITING YEAR

Early spring treatments in the fruiting year may be necessary to control germinating summer annual weeds when a late fall application of **simazine** or **Sinbar** was not used. They should also be considered for the control of annual grasses, volunteer grain and quackgrass.

Renovation and late fall treatments are used to clean-up the field for the next year, to maintain a sufficient concentration of residual herbicide near the soil surface to control germinating weeds in the late summer/early fall, and to provide residual control through the following spring/early summer. Growers should pull or spot spray weeds that have established during the planting year and the picking season. New weeds can be prevented from becoming established by using an appropriate preemergence herbicide.

V. HERBICIDE INJURY

Crop injury resulting from the use of herbicides is not uncommon, particularly on light soils. Most herbicide injury can be traced to using too high a rate on light soils, improper timing of sprays, improperly calibrated sprayers, sensitive cultivars and weak plants growing under unfavorable conditions. In most cases, the grower has some control over these factors. Any factor that injures the crop (other pests, winter injury, exposure of crowns and root systems as a result of erosion, improper mineral nutrition, wet spots in the field, etc.) will make the crop more susceptible to injury.

Newly planted and actively runnering strawberries are especially sensitive to herbicides. Crop tolerance increases in late summer and fall. This corresponds to the time when preemergence herbicides can be used to control many winter annual and perennial weeds. Growth regulator herbicides should not be applied when flower buds are forming.

Remember that light, sandy soils require less herbicide than heavier soils for comparable levels of weed control. Strawberries growing on soils low in organic matter are especially prone to herbicide injury. Accordingly, lower rates of herbicide should be used on fields low in organic matter (less than 2%). **Simazine** should not be used on soils with pH greater than 5.6.

To minimize the risk of crop injury growers must be careful not to exceed maximum recommended annual application rates. They should fully understand and follow the instructions on the product labels. Do not expect herbicides to control all weed problems. Understand that some hand work and cultivation will be required to obtain complete weed control. Weakened plants are more susceptible to herbicide injury. Conversely healthy established strawberries are most capable of tolerating recommended treatment rates.

VI. APPLICATION OF HERBICIDES

NOTES

Herbicides should be applied with an accurately calibrated boom sprayer. Backpack and airblast sprayers will not give sufficient uniform application and should not be used. For directions on sprayer calibration and determination of the amount of herbicide needed, refer to O.M.A.F. Publication 75 *Guide to Weed Control*. It is essential to set up the sprayer and operate it properly in order to eliminate overlap. Nozzle overlap within a boom swath depends on both nozzle spacing and boom height. Remember to adjust the boom to spray at the appropriate height above the target, either the ground or weed vegetation. Excessive overlap between boom swaths can result in a double application which will likely cause severe crop injury. This type of overlap is prevented by careful application. Various boom end marking systems can be used to delineate the outer edge of the swath pass.

Herbicides are usually applied through flat fan nozzles although there are new nozzles such as the Delavan Raindrops (TM) which may also be appropriate. Cone type nozzles will not provide a good pattern at the low pressure (100 to 200 kPa) recommended for herbicide application and therefore should not be used.

Refer to the product label for application volumes.

VII. NOTES ON HERBICIDES

All rates except for 2,4-D (#4) and simazine (#9) are given exclusively in terms of commercial product.

1. **Dacthal** 75 WP (chlorthal dimethyl).

At rates of 11.75 to 14.25 kg/ha Dacthal gives good control of annual grasses, field violet and purslane but it gives no control of most other common broadleaf weeds like mustards, ragweed, lamb's quarters and smartweeds. It has no foliar activity and gives no control of emerged grasses. It will control field violet in the cotyledon (seed leaf) stage. **Dacthal** may control germinating toadflax. It is effective only if the application is followed by rain or irrigation. **Dacthal** is only active in the soil where it acts by killing germinating seeds and is very safe to strawberries. It can be used soon after transplanting, in the early fall or in the spring of the fruiting year.

2. **Enide** 50 WP (diphenamid).

At rates of 9 to 13.5 kg/ha **Enide** controls annual grasses, volunteer cereals and some native grasses arising from seed. It will give some control of broadleaf weeds such as chickweed, lamb's quarters, pigweed,

TABLE 1
EFFECT ON HERBICIDES ON COMMON WEEDS

WEED	PREPLANT		PREEMERGENCE					PRE/EARLY POST-EMERGENCE		POSTEMERGENCE		
	ROUND UP	TREFLAN	DACTHAL	ENIDE	SINBAR	SIMAZINE	DEVRINOL	TENORAN	SINBAR	2, 4, -D	FUSILADE	KERB
PERENNIALS												
quackgrass	E	P	P	P	F	P	P	P	—	P	G	G
tufted vetch	P-G	P	P	G	P	P	P	P	P	F	P	P
sheep sorrel	G	—	—	—	G	G	—	P	?	P	P	G
toadflax	F	—	G?	—	?	?	—	P	P	P	P	P
buttercup	?	—	P	P	P	P	P	P	P	P	P	P
daisy	G	—	P	P	F-G	F-G	—	F	G	P	P	P
dandelion	F	—	G	—	G	G	P	P	G	G	P	P
yarrow	G	—	—	—	E	—	—	—	—	P	P	P
goat's beard	E	—	—	—	—	—	—	—	—	F	P	P
yellow wood-sorrel	G	?	—	—	—	—	—	—	—	P	P	P
plantain	G	—	—	—	G	G	P	F	G	G	P	P
stitchwort	E	P	P	P	E	E	P	E	E	P	P	E
horsetail	P	—	P	—	—	P	—	P	—	P	P	G
ANNUALS												
lamb's quarters[1]	E	G	G	G	E	E	F	F	E	E	P	—
mustards	E	P	P	—	E	E	P	P	E	E	P	P
annual grasses	E	E	G	G	G	F	G	P-G	G	P	E	F
volunteer cereals	E	E	G	E	G	F	E	P	G	P	E	E
corn spurry	E	?	F	P	P	G	G	—	F-G	P	P	G
hempnettle	E	—	P	P	G	G	—	—	G	P	P	—
chickweed	E	G	G	G	E	E	G	G	E	P	P	E
cudweed	E	—	—	—	E	E	E	—	E	F	P	—
pineapple weed	E	—	—	—	F-G	—	—	—	F-G	G	P	—
redroot pigweed[1]	E	G	F	G	F	E	G	G	F	E	P	—
groundsel[1]	E	—	P	P	F-E	?	G	F	F-E	F	P	—
ragweed[1]	E	—	P	—	E	E	G	G	E	G	P	—
field violet	E	?	E	P	F-G	F	P	—	F-G	P	P	—
smartweed	E	—	P	G	E	E	—	E	—	G	P	—
triazine resistant weeds	E	P-G	—	—	P-G	P	—	P-G	—	G	P	—

CONTROL RATINGS ON THIS CHART ARE GIVEN TO FACILITATE CHOOSING THE BEST TREATMENT AND ARE NOT A GUARANTEE OF PERFORMANCE.

[1]Biotypes of these species are known to occur that are resistant to simazine. They may also show a greater tolerance to Tenoran and Sinbar.

CONTROL RATING:

P - POOR
F - FAIR
G - GOOD
E - EXCELLENT
? - POSSIBLY EFFECTIVE
— - UNKNOWN

TABLE 2

SCHEDULE OF SEQUENTIAL WEED CONTROL PRACTICES
(choose one treatment as needed based on weed problem)

THE PLANTING YEAR					
WEED PROBLEM	PREPLANT	2-4 WEEKS	4-6 WEEKS	LATE SUMMER	LATE FALL
Rhizomatous perennials	Roundup				
Annual grasses and broadleaves	Treflan	Dacthal Enide	Sinbar		Sinbar Enide Devrinol
Annual broadleaves		Tenoran	Simazine	Tenoran	Simazine
Quackgrass and annual grasses		Fusilade ———	anytime ———	———	Kerb ▶
Winter annual and perennial seedlings				Sinbar Simazine Enide Devrinol	

THE FRUITING YEAR				
WEED PROBLEM	EARLY SPRING	RENOVATION	SOON AFTER	LATE FALL
Annual grasses and quackgrass	Fusilade	Fusilade ———	anytime ———	——— ▶ Kerb
Annual broadleaves and grasses	Sinbar Tenoran Devrinol Dacthal	2,4-D Amine	Sinbar Simazine Devrinol Tenoran	Sinbar Devrinol Simazine Enide

cudweed, corn spurry and smartweed, and possibly vetch arising from seed. **Enide** is not effective on emerged weeds. It is only active through the soil, and acts by killing seedling plants prior to emergence. **Enide** is very safe to strawberries two to four weeks after transplanting, and during the late summer through late fall of the planting year. It is also recommended during the late fall of the fruiting year. **Enide** will affect runner production when applied later than four weeks after transplanting and should not be used at this time or during other periods of active runnering.

3. **Tenoran** 50 WP (chloroxuron)

At rates of 9 to 13.5 kg/ha **Tenoran** will control labeled weeds when they are 3 to 5 cm tall. **Tenoran** must be applied in at least 300 L of water per hectare. No more than three applications of **Tenoran** should be used in the planting year. The younger the weed seedling, the more susceptible it is. It is effective on many annual broadleaf weeds although control of mustards is poor. Chickweed and stitchwort can be controlled during any stage of growth. Control of annual grasses has been variable. **Tenoran** is active in the soil via the root system, and to a lesser extent it is absorbed directly by the foliage. Its residual effectiveness in the soil is less than that of **Enide, Sinbar** or **simazine**.

Tenoran can cause chlorotic and necrotic blotching on strawberry leaves. However, the crop quickly outgrows this type of injury. It can be used to control seedling weeds throughout the planting year, up to 60 days before harvest and after renovation during the fruiting year.

4. **2,4-D Amine** (several brand names)

2,4-D amine should be used during renovation soon after harvest is complete, to control established susceptible weeds. Apply 1.0 kg of active ingredient per hectare (eg. **2,4-D Amine 500** at 2.0 L per hectare) for control of dandelion, plantain, burdock, wild carrot, primrose, daisy fleabane and many seedling winter annuals. Common perennial weeds that **2,4-D amine** will not control include toadflax, buttercup, yarrow, ox-eye daisy, goldenrod, tufted vetch, hawkweed, sheep sorrel, St. John's wort and many others once they are established. Use only the amine formulations of **2,4-D** as other formulations are too injurious to the crop. Mowing the upper leaves four to six days after application has been considered necessary to prevent **2,4-D** from moving into the strawberry crown and new runners.

2,4-D is absorbed through the foliage. It kills weeds by interfering with a number of physiological processes that control growth and development of the plants. Typical effects of **2,4-D** on weeds and the crop include twisting and bending of the stems and leaves. It has no significant soil activity.

NOTES

When applying **2,4-D amine** use low pressure and coarse spray to minimize drift as some nearby crops may be extremely sensitive to **2,4-D.**

5. **Devrinol** 50 WP (napropamide)

Devrinol can be used for control of germinating volunteer cereals, annual grasses and some annual broadleaf weeds including common groundsel. **Devrinol** is not effective on mustards. **Devrinol** may affect runnering and daughter plant establishment. Do not apply **Devrinol** in the spring of the planting year. **Devrinol** can be applied at 9.0 kg per hectare in the late summer through late fall period after the desired number of daughter plants have become established. It may also be applied in the spring of the picking year prior to bloom or any time after renovation except during active runnering and daughter plant establishment. **Devrinol** will not control established weeds. Therefore, make applications to clean cultivated beds. **Devrinol** is only active in the soil. It acts by inhibiting root growth of susceptible weeds. Incorporation by cultivation, irrigation or rainfall equivalent to 5 cm of water is essential. Make only one application of **Devrinol** per growing season.

6. **Fusilade** 250 E.C. (fluazifop-butyl)

For control of annual grasses, volunteer cereals and quackgrass apply **Fusilade** directly to weeds. There is little risk of crop injury. For barnyard grass and volunteer cereals use 0.8 L per hectare at the two to five leaf stage. To control crab grass and wild oats, use 1.0L of **Fusilade** per hectare at the two to five leaf stage. Foxtail grasses require 1.0 L of **Fusilade** per hectare and application must be made between the two to four leaf stage. For quackgrass control, use **Fusilade** at 2.0 L per hectare applied when quackgrass is growing actively and in the three to five leaf stage. Control will be reduced if application is made at an inappropriate stage of growth.

Fusilade can be applied to strawberries at any time except within thirty days of harvest. **Agral 90** must always be used with **Fusilade** at a rate of 0.1% by volume (1 L **Agral 90** in 1000 L of spray mixture). Apply in 100 to 175 L of water per hectare.

Fusilade is absorbed through the leaves, and translocates (moves) to the areas of active growth where it inhibits further growth. It is a slow acting herbicide. Injury symptoms on susceptible grasses may take up to two weeks to become apparent. Early symptoms will include cessation of growth and a gradual change of foliar color to yellow or purplish-green. Under less than ideal conditions quackgrass may not completely "burn" down. **Fusilade** rarely shows any soil activity.

NOTES

7. **Kerb** 50 WP (propyzamide)

Applied in late fall just before mulching, **Kerb** at 2.2 kg per hectare will control most established perennial grasses including quackgrass. However, control often breaks around mid-summer or under conditions of high fertility. **Kerb** will control established chickweeds, stitchwort and will suppress sheep sorrel and field horsetail. It is the only herbicide that will control buttercup. However, Kerb gives no control of most broadleaf weeds and should be tank mixed with either **simazine** or **Sinbar**. Because of the risk of crop injury, use on newly planted beds only when buttercups, chickweed, stitchwort or sheep sorrel are major problems. Spot spraying may be sufficient. **Kerb** is unlikely to injure beds being carried over after an initial harvest. **Kerb** should be applied late in the fall but before freeze-up. **Kerb** is a strong inhibitor of cell division in roots and shoots of overwintering susceptible weeds. It is only active in the soil.

8. **Roundup** 356 SN (glyphosate)

The primary use of **Roundup** is to control established weeds prior to working a field in preparation for planting. Apply to actively growing weeds at the appropriate growth stage as specified on the label. **Roundup** is absorbed by the foliage and translocated to above and below ground growing points.

Roundup kills susceptible plants by inhibiting growth. Treated plants lose their green color and slowly turn brown. **Roundup** will damage or kill most green plants. Therefore, care must be taken to prevent spray or spray drift contracting desirable vegetation. Adjacent strawberries can be injured or killed by **Roundup** spray drift.

Roundup should be applied at 6.25 to 12.5 L per hectare in 100 to 200 L water per hectare in the summer prior to planting when weeds are actively growing. Quackgrass should have at least five leaves. Perennial broadleaf weeds are most sensitive near flowering. Fields that have not been worked in several years should be plowed and/or disced in spring through mid-summer to stimulate weed growth. After application, allow one week for **Roundup** to translocate to the roots before plowing under. Do not wait until the field turns brown as this may result in reduced control.

9. **Simazine** (several brand names and formulations)

Simazine or **Sinbar** should be used as a "basic weed control program"[1] for annual broadleaf weeds in strawberry production. When used as described below, alone, or in sequence with **Sinbar, simazine** will be effective in providing residual control throughout the growing season.

NOTES

[1] *The basic weed control program refers to the primary method relied on to control most weeds. Other herbicides and cultivation are used to control weeds missed by the basic program. These other methods can be thought of as components of the "clean-up" program.*

Simazine becomes more active in limed soils and can cause severe crop injury. Generally, it should not be used when the pH is higher than 5.6. **Simazine** has little foliar activity, and therefore, emerged weeds should be removed by cultivation before application.

Simazine kills susceptible weeds by inhibiting photosynthesis. **Simazine** is primarily active in the soil where it is absorbed by the roots and translocated to the green leaves where photosynthesis takes place. Weeds and strawberry plants injured by simazine develop chlorotic (yellow) and necrotic (dead) leaves. On susceptible strawberry cultivars, the chlorosis may be restricted to a band around the margins of the leaves or entire leaves may be affected.

In the planting year, **simazine** can be used up to three times. It should be applied in at least 200 L of water per hectare. At four to six weeks after transplanting use a rate of 0.5 kg active ingredient per hectare for control of summer annuals. During late summer an additional 0.5 kg of active ingredient can be applied as a "booster shot" to improve control of the "flush" of weeds that germinate during September and October. This late summer/early fall treatment of either **simazine** or **Sinbar** is essential to obtain clean fields in the picking year. **Simazine** can also be used late in the fall prior to mulching at a rate of 1.1 to 1.6 kg active ingredient per hectare. The main purpose of this treatment is to provide residual weed control next spring until harvest is complete.

In the picking year, **simazine** can be used following the after-harvest renovation at a rate of 0.8 to 1.2 kg active ingredient per hectare. This will provide control of summer annual and fall germinating broadleaf weeds. A late fall application of 1.1 to 1. 6 kg active ingredient per hectare will control germinating summer annual weeds the following spring.

In addition to pH, soil organic matter and soil texture have a major influence on the activity of simazine. A given rate of **simazine** will be more effective on weeds and potentially more injurious to the crop on a sandy, low organic matter soil than on a silt or clay loam with high organic matter content. Lower rates should be used on sandy soils and those low in organic matter. Do not use on soils containing less than 2% organic matter.

10. **Sinbar** 80 WP (terbacil)

Sinbar can be used as an alternate to or can be used in sequence with **simazine** as the "basic weed control program" for annual broadleaf weeds and grasses. **Sinbar** is not affected by soil pH and, therefore, can be used on limed soils. However, the same cautions regarding light textured, low organic matter soils discussed regarding **simazine** should also be observed with **Sinbar.**

NOTES

At equivalent rates to **simazine, Sinbar** will give better weed control but will be more likely to cause crop injury. Like **simazine, Sinbar** inhibits photosynthesis, and is active in the soil where it is absorbed by plant roots and translocated to the leaves. Injury symptoms to weeds and the crop are similar of **simazine. Sinbar** has more foliar activity than **simazine** and will control many small weeds when applied postemergence. **Sinbar** is also residual in the soil and when used sequentially as described below, alone, or alternately with **simazine**, it will provide season-long weed control. **Sinbar** controls most annual broadleaf weeds and is especially active against annual grasses and volunteer cereals arising from seed. The margin of safety to the crop is narrower with **Sinbar** than with other herbicides. Therefore a properly calibrated sprayer and proper application technique to avoid excessive over-lap is very important. Certain cultivars like Kent, Micmac, Bounty and Midway are more sensitive than others to **Sinbar.** Cautions regarding soil texture and reduced rates should be closely observed when using **Sinbar** with these cultivars, especially on light soils.

Sinbar can be used at 0.275 to 0.55 kg per hectare four to six weeks after planting to control summer annual broadleaf weeds and grasses. **Sinbar** can inhibit rooting of daughter plants. Therefore application must be done before new daughter plants start to root. This application will provide good residual weed control through late summer. A second "booster shot" application of 0.18 to 0.30 kg per hectare (**simazine** could be used alternatively) should be applied no later than mid-September to provide control of fall germinating annual and perennial weeds. A third application of 0.65 to 0.85 kg per hectare can be made in the late fall prior to mulching to give residual control of germinating weeds in the following spring through to completion of harvest.

During the picking year 0.275 to 0.350 kg per hectare can be applied in the spring prior to picking to control summer annuals. This treatment should only be used if there are significant numbers of germinating summer annual weeds and when the crop growth is vigorous. Following renovation procedures, 0.66 to 0.84 kg per hectare can be applied to control germinating summer annuals and fall germinating weeds. A late fall treatment of 0.65 to 0.85 kg per hectare will provide residual control the following spring. Apply **Sinbar** in at least 300 L of water per hectare.

11. **Treflan** 545 EC (trifluralin)

Treflan will control annual grasses, volunteer cereals and some broadleaf weeds including lamb's quarters, redroot pigweed and chickweed. **Treflan** must be applied to a thoroughly prepared seedbed and incorporated by double discing or harrowing with an s-tyne type harrow at right angles or by the use of a power cultivator. It has no foliar activity. **Treflan** inhibits cell division in the emerging shoots of germinating weed seeds. Use a rate of 2.1 L per hectare in heavy soil. **Treflan** will not control established weeds. Weed control may be inadequate in clay of in cold, wet soils.